

WHAT IS CLAIMED IS:

1. A point to multipoint communication system for providing broadband wireless communication between a first computer network and one or more other computer networks comprising:

a hub comprising:

an interface to the first computer network;

a plurality of primary communication link interfaces; and

a redundant communication link interface;

and

a plurality of nodes geographically spaced apart from the hub, each one of said nodes comprising:

an interface to at least one of the other computer networks; and

a remote communication link interface;

whereby, for each node, at least one primary communication link is established between the remote communication link interface at the node and at least one of the plurality of primary communication link interfaces at the hub; and

whereby, for each node, a redundant communication link is established between the remote communication link interface at the node and the redundant communication link interface at the hub.

2. The communication system of Claim 1 further comprising:

a second hub comprising:

an interface to a second computer network different from the first computer network and the one or more other computer networks;

a second plurality of primary communication link interfaces; and

a second redundant communication link interface;

and

a second plurality of nodes geographically spaced apart from either the second hub, each one of said second plurality of nodes comprising:

an interface to a computer network other than the first or second computer network or said one or more other computer networks; and

a remote communication link interface;

whereby, for each of said second plurality of nodes, at least one primary communication link is established between the remote communication link interface at the node and at least one of the plurality of primary communication link interfaces at the second hub; and

whereby, for each of said second plurality of nodes, a redundant communication link is established between the remote communication link interface at the node and the redundant communication link interface at the second hub.

3. The communication system of Claim 1 wherein said broadband wireless communication comprises bursty data.

4. The communication system of Claim 1 wherein at least one of the primary communication links is adaptive time division duplexed in the millimeter frequency range.

5. The communication system of Claim 4 wherein the adaptive time division duplexing is dynamically adjustable as a function of the forward and reverse data traffic on the primary communication link.

6. The communication system of Claim 5 wherein said redundant communication link is adaptive time division duplexed in the millimeter frequency range.

7. The communication system of Claim 6 wherein the adaptive time division duplexing is dynamically adjustable as a function of the forward and reverse data traffic on the redundant communication link.

8. The communication system of Claim 1 wherein at least one of the primary communication link interfaces provides a substantially independent primary communication link to each of at least two nodes.

9. The communication system of Claim 1 wherein the communication capacity of said redundant communication link interface is substantially the same as the communication capacity of one of said plurality of primary communication link interfaces.

10. The communication system of Claim 1 wherein said plurality of primary communication link interfaces are each operatively connected to a first communication processor.

11. The communication system of Claim 10 wherein said redundant communication link interface is operatively connected to a second communication processor.

12. The communication system of Claim 11 wherein said plurality of primary communication link interfaces are each associated with a primary sector of a service area and said redundant communication link interface is associated with a redundant sector of said service area.

13. The communication system of Claim 12 wherein said redundant sector is substantially coextensive with one or more of said primary sectors.

14. The communication system of Claim 12 wherein each of said plurality of primary communication link interfaces and said redundant communication link interface is a radio module.

15. The communication system of Claim 14 wherein said radio modules are adapted to facilitate rapid field replacement.

16. The communication system of Claim 11 further comprising a second redundant communication link interface at the hub wherein said second redundant communication link interface is operatively connected to said second communication processor.

17. The communication system of Claim 16 wherein said second redundant communication link interface establishes a redundant communication link with a node other than a node of said plurality of nodes.

18. The communication system of Claim 16 wherein said first communication processor is a first modem and said second communication processor is a second modem.

19. The communication system of Claim 18 wherein said first and second processors are multiport modems.

20. The communication system of Claim 19 wherein said first modem is capable of transmitting and receiving said data at multiple levels of information density.

21. The communication system of Claim 1 wherein at least one of said first computer network or of said one or more other computer networks is a public switched telephone network.

22. The communication system of Claim 1 wherein at least one of said first computer network or of said one or more other computer networks is a private branch exchange.

23. The communication system of Claim 1 wherein at least one of said first computer network or of said one or more other computer networks is a router.

24. The communication system of Claim 1 wherein at least one of said first computer network or of said one or more other computer networks is the internet.

25. A point to multipoint communication system for providing broadband wireless communication between a first computer network and one or more other computer networks comprising:

a hub comprising:

an interface to the first computer network;

a plurality of primary communication link interfaces; and

a plurality of redundant communication link interfaces;

and

a plurality of nodes geographically spaced apart from the hub, each one of said nodes

comprising:

an interface to at least one of the other computer networks; and

a remote communication link interface;

whereby, for each node, at least one primary communication link is established between the remote communication link interface at the node and at least one of the plurality of primary communication link interfaces at the hub; and

whereby, for each node, at least one redundant communication link is established between the remote communication link interface at the node and at least one of the plurality of redundant communication link interfaces at the hub.

26. The communication system of Claim 25 wherein the number of primary communication link interfaces equals the number of redundant communication link interfaces.

27. The communication system of Claim 25 wherein each of said plurality of primary communication link interfaces are operatively connected to a unique one of a plurality of communication processors.

28. The communication system of Claim 25 wherein said plurality of primary communication link interfaces are each operatively connected to a first communication processor.

29. The communication system of Claim 28 wherein said plurality of redundant communication link interfaces are each operatively connected to a second communication processor.

30. The communication system of Claim 25 wherein the number of primary communication link interfaces is greater than the number of redundant communication link interfaces.

31. The communication system of Claim 30 wherein said plurality of primary communication link interfaces are each associated with a primary sector of a service area and said plurality of redundant communication link interfaces are each associated with a redundant sector of said service area.

32. The communication system of Claim 31 wherein each of said primary sectors are substantially 30° in azimuth and each of said redundant sectors is substantially 90° in azimuth.

33. The communication system of Claim 31 wherein each of said primary sectors are substantially 45° in azimuth and each of said redundant sectors is substantially 90° in azimuth.

34. The communication system of Claim 31 wherein each of said primary sectors is either substantially 30° or substantially 60° in azimuth and each of said redundant sectors is substantially 90° in azimuth.

35. The communication system of Claim 31 wherein each of the plurality of primary communication links operates on a channel unique from the channels on which the other primary communication links operate.

36. The communication system of Claim 35 wherein each of the plurality of redundant communication links operates on a channel unique from the channels on which the primary communication links operate.

37. The communication system of Claim 36 wherein for each of the plurality of nodes, the remote communication link interface is adapted to operate on one of a plurality of channels such that the node can communicate with the hub over the primary communication link and the redundant communication link which serves the service area sector in which the node is located.

38. A method of providing point to multipoint communication for broadband wireless communication between a first computer network and one or more other computer networks comprising:

providing a hub comprising:

an interface to the first computer network;

a plurality of primary communication link interfaces; and

a plurality of redundant communication link interfaces;

and

providing a plurality of nodes geographically spaced apart from the hub, each one of said nodes comprising:

an interface to at least one of the other computer networks; and

a remote communication link interface;

establishing, for each node, at least one primary communication link between the remote communication link interface at the node and at least one of the plurality of primary communication link interfaces at the hub; and

establishing, for each node, at least one redundant communication link between the remote communication link interface at the node and at least one of the plurality of redundant communication link interfaces at the hub.

39. The communication method of Claim 38 wherein the number of primary communication link interfaces equals the number of redundant communication link interfaces.

40. The communication method of Claim 38 wherein each of said plurality of primary communication link interfaces are operatively connected to a unique one of a plurality of communication processors.

41. The communication method of Claim 38 wherein said plurality of primary communication link interfaces are each operatively connected to a first communication processor.

42. The communication method of Claim 41 wherein said plurality of redundant communication link interfaces are each operatively connected to a second communication processor.

43. The communication method of Claim 38 wherein the number of primary communication link interfaces is greater than the number of redundant communication link interfaces.

44. The communication method of Claim 43 wherein said plurality of primary communication link interfaces are each associated with a primary sector of a service area and said plurality of redundant communication link interfaces are each associated with a redundant sector of said service area.

45. The communication method of Claim 44 wherein each of said primary sectors are substantially 30° in azimuth and each of said redundant sectors is substantially 90° in azimuth.

46. The communication system of Claim 44 wherein each of said primary sectors are substantially 45° in azimuth and each of said redundant sectors is substantially 90° in azimuth.

47. The communication system of Claim 44 wherein each of said primary sectors is either substantially 30° or substantially 60° in azimuth and each of said redundant sectors is substantially 90° in azimuth.

48. The communication method of Claim 44 wherein each of the plurality of primary communication links operates on a channel unique from the channels on which the other primary communication links operate.

49. The communication method of Claim 48 wherein each of the plurality of redundant communication links operates on a channel unique from the channels on which the primary communication links operate.

50. The communication method of Claim 49 wherein for each of the plurality of nodes, the remote communication link interface is adapted to operate on multiple channels such that the node can communicate with the hub over the primary communication link and the redundant communication link which serve the service area sector in which the node is located.

51. The communication method of Claim 44 further comprising:

establishing communications over at least one of the plurality of primary communication links between the hub and one or more nodes of said plurality of nodes;

determining an undesirable link condition for the primary communication link serving one node of said plurality of nodes; and

establishing communications over the redundant communication link serving said one node.

52. The communication method of Claim 51 wherein said step of determining an undesirable link condition comprises at least one of the steps of:

- (a) detecting the loss of communications for a predetermined amount of time;
- (b) detecting a bit error rate greater than a predetermined threshold;
- (c) detecting a signal attribute outside a predetermined range;
- (d) detecting a signal to noise ratio less than a predetermined threshold; or
- (e) detecting a carrier to noise ratio less than a predetermined threshold.

53. The communication system of Claim 51 wherein each of the plurality of primary communication links operates on a channel unique from the channels on which the other primary communication links operate.

54. The communication system of Claim 53 wherein each of the plurality of redundant communication links is capable of operating on one of a first plurality of channels unique from the channels on which the primary communication links operate.

55. The communication system of Claim 54 wherein for each of the plurality of nodes, the remote communication link interface is adapted to operate on a second plurality of channels which includes said first plurality of channels such that the node can communicate with the hub over the primary communication link and the redundant communication link which serves the service area sector in which the node is located.

56. The communication method of Claim 55 wherein the step of establishing communications over the redundant communication link comprises the step of:

dynamically selecting the channel over which the redundant communication link will operate such that the redundant communication link channel is the same as the channel over which the failed primary communication link operated.

57. The communication method of Claim 55 wherein the step of establishing communications over the redundant communication link comprises the step of:

dynamically selecting the channel over which the redundant communication link will operate such that the redundant communication link channel is different than the channel over which the failed primary communication link operated.

58. The communication method of Claim 55 wherein the step of establishing communications over the redundant communication link comprises the step of:

dynamically selecting the channel over which the redundant communication link will operate such that the redundant communication link channel is different than the channel over which the failed primary communication link operated and is different than the channel over which each operating primary and secondary communication links is operating.

59. The communication system of Claim 38 wherein at least one of said first computer network or of said one or more other computer networks is a public switched telephone network.

60. The communication system of Claim 38 wherein at least one of said first computer network or of said one or more other computer networks is a private branch exchange.

61. The communication system of Claim 38 wherein at least one of said first computer network or of said one or more other computer networks is a router.

62. The communication system of Claim 38 wherein at least one of said first computer network or of said one or more other computer networks is the internet.